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ABSTRACT

To investigate the resistance to extinction in mentally handicapped children under conditions of stimulus variation, three experiments involving mildly retarded children were conducted. Test procedures were altered somewhat in each case (the new learning task chosen for the second experiment being a reversal shift of experiment one), and the third experiment being a continuation of one which was an investigation of resistance to extinction as a function of the number of stimulus components common to acquisition and extinction. It was felt that the three experiments together provided a strong support for a stimulus variation explanation of extinction, as well as indicating that attempts to try alternative responses in extinction were retarded when the stimulus conditions of acquisition and extinction were similar. (CD)

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RESISTANCE TO EXTINCTION IN MENTALLY RETARDED CHILDREN UNDER CONDITIONS OF STIMULUS VARIATION

Project No. 7-G-073
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Gladys Hiner and Wayne Viney

March, 1969

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STATEMENT OF PROBLEM

The purpose of the present proposal was to investigate resistance to extinction in mentally retarded children while systematically varying stimuli common to acquisition and extinction conditions. A second purpose involved a study of response reversal (reversal shifts) while systematically varying stimuli common to initial and reversal learning conditions. This type of research with retardates seems important since stimulus variation explanations of response reversal and extinction may help account for such troublesome problems as the extreme persistence or rigidity of some responses, variations in resistance to extinction, and variations in learning reversals or alternative responses.

Experiment 1

Considerable experimental evidence (e.g., Hulicka, Capehart & Viney, 1960; Mackintosh, 1955; & Marx, 1960) supports the hypothesis that resistance to extinction is partly a function of the degree of uniformity between the stimulus conditions of acquisition and the stimulus conditions of extinction. Viney, Hulicka, Bitner, Raley and Brewster (1968) have also demonstrated slower response shifting as a function of similarity between the stimulus conditions of a first learning task and those of a second learning task. This latter finding indicates a decreasing probability of attempting alternative responses in extinction as a function of similarity of stimulus components which are common to acquisition and extinction. The support for this explanation of resistance to extinction is generally provided by animal research. The little research which has been reported with human subjects (e.g., Myers & Myers, 1962) has studied variation of only one stimulus such as a buzz or click. Since explanations based on stimulus variation seem especially pertinent in the case of increasingly complex associative possibilities (as in human subjects), it is important to study variation of a dimensionalized type (Jones, 1953) or variation of several specifiable stimuli (Viney et al., 1968). Accordingly,

the present experiments were designed to investigate resistance to extinction and response reversal in human subjects who are mildly retarded while systematically varying stimuli common to acquisition and extinction conditions. For comparative purposes, the first experiment was quite similar to the Hulicka et al. (1960) and Viney et al. (1968) studies.

Objective

To investigate the number of responses to extinction made by retarded children as a function of the number of stimulus components which are common to acquisition and extinction.

Method

Subjects

Sixty retarded children (thirty male and thirty female) served as subjects. All Ss were from schools located in a middle-class section of Oklahoma City. The mean CA of Ss was 9 to 10 years.

Apparatus and Materials

The apparatus was a two-choice discrimination device made of 3/8 inch unpainted plywood. A 20 x 18 ins. panel contained a window for displaying the discriminanda, activating mechanisms,

and delivery mechanisms. The window ($4\frac{1}{4}$ in. high x 8 in. wide) was centered $2\frac{1}{2}$ inches from the top of the panel. An opaque masonite panel could be raised and lowered in front of the window for purposes of displaying and changing the discriminanda. Equally spaced three inches below the window were two push buttons six inches apart. The push buttons were located so as to correspond to the two discriminanda presented in the window. Located four inches from the bottom part of the panel were two openings and containers into which marble rewards could be delivered The containers were located so as to correspond to the activating buttons and the discriminanda. Marbles were delivered via Standard Foringer Marble dispensers which were located behind the panel. In addition to the marble, five other stimuli could be activated by pushing the correct button. They included: a click caused by the operation of the delivery mechanism, a red light located on the front panel near the left delivery slot, a bell and a buzzer located behind the panel. Each stimulus could be activated by E as experimental conditions required. Discriminanda consisted of a 3 cm. square, a 2 cm. square, and a 1 cm. square.

Procedure

All Ss were tested invididually in a small quiet room in which E and S were alone. Ss were told that they were going to

play a game in which they could win marbles. E then demonstrated how pushing a button could result in the delivery of a marble. Ss were then told that the object of the game was to win a marble on every trial. It was further explained that at the completion of the game the marbles could be exchanged for a toy. At this point, Ss were allowed to inspect a display consisting of a wide variety of inexpensive toys. Immediately after examination of the toys, acquisition training was begun.

Acquisition training was identical for all Ss. The three discriminanda were presented two at a time in random combinations with the smaller discriminandum always being reinforced. Position was irrelevant with the small square appearing on the left and right on a random basis. In addition to the marble, a correct response was always accompanied by all five of the conditioned stimuli. When Ss choose the larger of the two discriminanda, they were not rewarded and none of the conditioned stimuli appeared. The learning criterion consisted of twelve successive correct choices.

Extinction training was begun immediately upon completion of acquisition training with no further instructions being given. Six extinction groups varied in terms of the number of manipulable stimuli present during extinction which were also present during acquisition according to the procedure presented in Table 1.

Table 1

Number of Stimuli Present for Each
Extinction Group

Group	N	No. Stimuli	No. Combinations
1	10	5	1
2	10	4	5
3	10	3	10
4	10	2	10
5	10	1	5
6	10	0	1

Thus, each button-press during extinction activated from 0 to 100% of the stimuli which previously accompanied the marble reinforcement. After the second extinction trial Ss were told that they could stop playing the game when they wished. The extinction criterion consisted of S informing E that he no longer wished to play the game.

Results and Discussion

The original data consisting of trials to criterion for acquisition and extinction are presented in Appendices 1 and 2. Analysis of the acquisition scores of the various extinction subgroups failed to reveal any significant differences ($F < 1.00$ for both number of stimuli and sex.) Groups were, therefore, considered equivalent prior to extinction training. Means and SD's of the various extinction groups are presented in Table 2. Because the data were heterogeneously variable (F max = 86.50) a $\sqrt{x + .5}$ transformation was performed prior to proceeding with the analysis. The

Table 2

Means and SD's of All Extinction Groups in Experiment One

Group	No. Stimuli	Male Subjects		Female Subjects	
		$\bar{X}$	SD	$\bar{X}$	SD
1	5	55.60	19.50	36.00	7.96
2	4	49.80	8.93	34.00	14.05
3	3	39.00	15.34	30.20	6.11
4	2	14.40	7.38	15.40	2.39
5	1	10.60	3.92	8.00	2.10
6	0	17.20	5.60	13.00	4.09

transformation reduced heterogeneity (F max = 5.47) sufficiently to proceed with the analysis of variance. Because the sex variable was of little theoretical interest, data for the sexes were combined, and a simple one-way analysis (based only on the 6 extinction groups) was performed. A summary of the analysis is presented in Table 3. The analysis directly supports the position

Table 3

Summary of Analysis of Variance Based on Extinction Data

Source	SS	df	MS	F	P
Between	117.21	5	23.44	24.16	.001
Within	52.40	54	.97		

that resistance to extinction is a positive function of commonality between the stimulus conditions of acquisition and extinction. In order to analyze differences between individual group means an a posteriori test (Scheffé, 1953) was conducted. A summary of the Scheffé test is presented in Table 4. These results are completely supportive of the Hulicka et al. (1960) study conducted with rats and a more recent study (Viney, Hulicka, Raley, Bitner &

Brewster, 1968) conducted with human Ss. The results have implications for programs designed to eliminate unwanted or undesirable responses, but they also raise questions concerning the effects of stimulus variation upon learning of alternative responses. Accordingly, Experiment 2 was conducted as an extension of Experiment 1 in order to test the effects of stimulus

Table 4

Summary of Individual Group Comparisons

Based on the Scheffé Test

	5	4	3	2	1	0
5			*	*	*	*
4				*	*	*
3				*	*	*
2						
1						

* Significant at the .01 level

variation upon the learning of alternative responses. In this design Ss had not only to extinguish one response, but they had to learn another in its place. The effect of stimulus variation upon new learning was the major point of interest. Another major

point of interest was whether new learning would be effected differently in normal and retarded Ss as a function of stimulus variation

Experiment 2

Because of its theoretical interest, the new learning task chosen for the second experiment was a reversal shift in which the formerly positive stimulus becomes negative, and the formerly negative stimulus becomes positive. Most researchers have attributed variations in reversal shift performance to internal variables such as verbal mediation (e.g., Kendler & Kendler, 1959). To date, however, there has been little effort to identify specifiable stimulus conditions which might effect reversal performance. The suggestion of Experiment 1 is that reversal performance might be retarded when the stimulus conditions of the first and second tasks are fairly similar. Reversal performance, however, might be facilitated when the stimulus conditions of the first and second tasks are dissimilar. Experiment 2 was designed to explore this possibility along with a possible differential effect of stimulus variation upon normal and retarded Ss equated for MA.

Objective

To investigate speed of learning reversal shifts in normal and retarded children as a function of similarity of stimulus

components common to initial and reversal learning conditions.

Subjects

Seventy-two retarded and seventy-two normal children equated for MA (MA for retardates was 7.13, for normals 7.05) participated in the study. Ss were obtained from special education and regular classes from 8 different public schools in Oklahoma City, Oklahoma.

Apparatus and Materials

The apparatus was a two-choice discrimination device made of 3/8 inch unpainted plywood. A 20 x 18 ins. panel contained a window for displaying the discriminanda, activating mechanisms, and delivery mechanisms. The window ($4\frac{1}{4}$ in high x 8 in. wide) was centered $2\frac{1}{2}$ inches from the top of the panel. An opaque masonite panel could be raised and lowered in front of the window for purposes of displaying and changing the discriminanda. Equally spaced three inches below the window were two push buttons six inches apart. The push buttons were located so as to correspond to the two discriminanda presented in the window. Located four inches from the bottom part of the panel were two openings and containers into which marble rewards could be delivered. The containers were located so as to correspond to the activating buttons and the discriminanda. Marbles were delivered via Standard Foringer

Marble dispensers which were located behind the panel. In addition to the marble, five other stimuli could be activated by pushing the correct button. These included: a click caused by the operation of the delivery mechanism, a red light located on the front panel near the left delivery slot, a bell and a buzzer located behind the panel. Each stimulus could be activated or inactivated by E as experimental conditions required. Discriminanda consisted of a 3 cm. square, a 2 cm. square, and a 1 cm. square.

Procedure

All Ss were tested individually in a small quiet room in which E and S were alone. Ss were told that they were going to play a game in which they could win marbles. E then demonstrated how pushing a button could result in the delivery of a marble. Ss were then told that the object of the game was to win a marble on every trial. It was further explained that at the completion of the game the marbles could be exchanged for a toy. At this point, Ss were allowed to inspect a display consisting of a wide variety of inexpensive toys. Immediately after examination of the toys, acquisition training was begun.

Acquisition Training

One-third of the subjects received initial training with the positive (reward producing) discriminandum accompanied by the five manipulable stimuli (described in Experiment 1). Another

one-third received initial training on the positive discriminandum without the accompanying stimuli. The remaining one-third received initial training with the manipulable stimuli accompanying the negative discriminandum. The discriminanda were presented in pairs of 2 with the smaller discriminandum being positive for half of the Ss while the larger discriminandum was positive for the other half. Learning criterion was twelve successive correct choices.

Reversal Training

Following initial learning conditions, Ss were required to perform a reversal shift. A reversal shift refers to the formerly positive stimulus becoming negative (no longer producing reward) while the formerly negative stimulus becomes positive (produces reward). The basic experimental procedure is outlined in Table 5 The reversal learning criterion consisted of twelve consecutive correct choices to the new cue situation. After Ss reached criterion, they traded their marbles for a toy and were dismissed.

Table 5

Experimental Design for Experiment Two

Condition	Initial Learning No. of Manipulable Stimuli Accompanying Discriminandum		Reversal Learning No. of Manipulable Stimuli Accompanying Discriminandum	
	Positive Discrim.	Negative Discrim.	Positive Discrim.	Negative Discrim.
1	5	0	5	0
2	5	0	0	5
3	5	0	0	0
4	0	0	5	0
5	0	0	0	5
6	0	0	0	0
7	0	5	5	0
8	0	5	0	5
9	0	5	0	0

Results and Discussion

A 2 x 3 x 3 analysis of variance conducted on initial learning trials failed to reveal any significant differences for any of the main effects or interactions. The location of the manipulable stimuli, therefore, was presumed to have no effect upon initial learning speed. Further, retarded and normal Ss equated for MA learned the initial problem with equal facility. Appendices 3 and 4 contain the original data for initial and test learning conditions.

The second analysis (also of the 2 x 3 x 3 variety) was conducted on the test (reversal) learning task. Data for both sexes were combined for purposes of analysis because the sex variable was of little theoretical interest to the study. Table 6 presents means and SD's of test problem performance for all experimental groups. The only significant effect as illustrated in Table 7 was the interaction between stimulus location in acquisition and stimulus location in the test problem ($F = 2.76$, df, 4/126, $P < .05$). The location of the stimuli during initial and test problems taken separately produced no effect, but when the stimulus conditions of the test problems are similar to those of the initial problems, reversal performance is retarded. The learning of an alternative (reversal) response is, thus, retarded with increasing commonality between the stimulus conditions of initial and test problems.

Table 6

A Summary of Means and SD's of Test Problem Performance for all Experimental Groups

Location of Stimuli During Acquisition		Location of Stimuli During the Test Problem					
		formerly + cue		formerly - cue		no stimuli	
		Normal	Retarded	Normal	Retarded	Normal	Retarded
+ cue	M	14.12	20.12	10.00	5.75	11.00	9.50
	SD	6.65	9.77	7.06	4.54	7.84	7.91
- cue	M	8.00	8.62	7.50	10.38	13.50	6.25
	SD	8.09	7.61	4.27	5.19	9.63	3.41
no stimuli	M	9.38	8.75	9.50	11.00	9.25	10.38
	SD	6.46	3.46	4.82	9.20	3.93	9.98

Table 7

Summary Table of Analysis of Test Trials

for all Experimental Groups

Source	SS	df	MS	F	P
A Learner	1.01	1	1.01		
B Stimulus location in acquisition	191.17	2	95.58	1.70	
C Stimulus location in extinction	150.04	2	75.02	1.34	
A x B	23.16	2	11.58		
A x C	124.54	2	62.27	1.11	
B x C	619.79	4	154.95	2.76	.05
A x B x C	337.05	4	84.26	1.50	
Error	7077125	126	56.17		

Control groups involving no stimuli in the initial problem and stimuli associated with the negative cue were apparently unnecessary as there were no differences in extinction groups following these acquisition conditions

Experiment 3

Experiment 3 consisted of a further test of objective #1, i.e., an investigation of resistance to extinction as a function of number of stimulus components common to acquisition and extinction. In this experiment different rooms were used for the training and test problems.

Subjects

Forty retarded children served as subjects. All Ss came from schools located in a middle-class section of Oklahoma City. Mean CA of Ss was 10.1 years.

Apparatus and Materials

The apparatus was a two-choice discrimination device made of 3/8 inch unpainted plywood. A 20 x 18 ins. panel contained a window for displaying the discriminanda, activating mechanisms, and delivery mechanisms. The window ($4\frac{1}{4}$ in. high x 8 in. wide) was centered $2\frac{1}{2}$ inches from the top of the panel. An opaque masonite panel could be raised and lowered in front of the window for purposes of displaying and changing the discriminanda. Equally spaced three inches below the window were two push buttons six inches apart. The push buttons were located so as to correspond to the two discriminanda presented in the window. Located four inches

from the bottom part of the panel were two openings and containers into which marble rewards could be delivered. The containers were located so as to correspond to the activating buttons and the discriminanda. Marbles were delivered via Standard Foringer Marble dispensers which were located behind the panel. In addition to the marble, five other stimuli could be activated by pushing the correct button. These included: a click caused by the operation of the delivery mechanism, a red light located on the front panel near the left delivery slot, a bell and a buzzer located behind the panel. Each stimulus could be activated or inactivated by E as experimental conditions required. Discriminanda consisted of a 3 cm. square, a 2 cm. square, and a 1 cm. square.

Procedure

All subjects were given identical acquisition training with the smaller discriminandum always producing reward regardless of position. None of the manipulable stimuli were utilized in either acquisition or extinction in this experiment. Criterion for acquisition training again consisted of 12 successive correct choices.

Extinction Training

Subjects were divided into 2 extinction groups. Extinction procedures were identical for the 2 groups with the exception that

one group was extinguished in the room in which they were given acquisition training, while the other group was moved to a new room for extinction training. There was a 5 minute interval between acquisition and extinction for both groups.

Results and Discussion

The original data consisting of trials to criterion for acquisition and extinction are presented in Appendices 5 and 6. Means and SD's based on trials to criterion for both acquisition and extinction are presented in Table 8. Data from both sexes were again combined for purposes of analysis. An analysis of

Table 8

A Summary of Means and SD's
for Acquisition and Extinction Groups
of Experiment Three

	Extinction in Same Room		Extinction in New Room	
	Acquisition	Extinction	Acquisition	Extinction
Mean	15.50	32.15	13.10	13.85
SD	10.80	24.61	7.45	7.18

variance conducted on the acquisition data indicated statistical equivalence of the two groups (F 1.00). Analysis of the extinction data, however, indicated a highly reliable effect (F = 9.57, df 1/38, P < .01) attributable to the different extinction rooms.

Experiment 3 supports the findings of Experiment 1 and provides further support for a stimulus variation explanation of extinction. Apparently, large numbers of stimuli may serve as secondary reinforcers or conditioned stimuli. The greater the number of conditional stimuli associated with a response, the greater the resistance to extinction.

Summary

The three experiments together provide strong support for a stimulus variation explanation of extinction. The results also indicate that attempts to try alternative responses in extinction are retarded when the stimulus conditions of acquisition and extinction are similar.

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APPENDICES

Appendix 1

Original Data Consisting of Trials to Criterion in Acquisition Training in Experiment One

Acquisition Groups					
1	2	3	4	5	6
2	8*	5	9*	9*	4
12	23	32	7	14*	53
27*	17*	3*	9*	9	22*
16	0	3	14*	40	29*
10	45*	5	40	17*	37*
1*	6	40	0	5*	2
3*	3*	30*	3	23*	22
2*	16	8*	15*	23	15
5*	17*	16	37	1	2*
7	4	19*	26*	3	14*

* Female subjects.

Appendix 2

Original Data Consisting of Trials to Extinction Criterion in Experiment One

Number of Conditioned Stimuli					
5	4	3	2	1	0
87	41*	67	15*	6*	25
37	40	35	13	10*	9
26*	9*	26*	15*	14	16*
33	43	42	13*	5	16*
63	38*	27	10	5*	8*
41*	62	24	10	10*	19
36*	51*	29*	29	15*	20
31*	45	35*	14*	9	13
49*	31*	39	10	7	8*
173	59	22*	20*	12	17*

* Female subjects.

Appendix 3

Original Data Consisting of Trials to Criterion
in the Initial Problem in Experiment Two

Location of Stimuli During Acquisition	Location of Stimuli During the Test Problem					
	formerly + cue		formerly - cue		no stimuli	
	Normal	Retarded	Normal	Retarded	Normal	Retarded
With Positive Cue	4	7	31	8	0*	19*
	20	3	19	3	6	32
	2	18	10	8*	4	4*
	14	30*	9	44*	18*	19*
	4	0*	31	7	0	6
	0	19*	33*	19	7*	10*
	14	7*	20	18	28*	27
	28*	30	4	12	9*	23
With Negative Cue	4*	8	8	29	1*	21*
	4	2	1	7	18	1*
	19*	16*	3*	17*	11	17
	2	33	17*	8*	7	25
	8	6*	12	41*	10*	6*
	6	3*	6	4	3*	11*
	17	2	5	13*	16*	2
	22	29*	11	3*	22	30
No Stimuli	6*	7	17*	2	4*	15
	37*	0	15*	27	8*	10*
	3*	44	38	4*	13*	0*
	12	17	13*	27	25	24
	15*	10	14*	1*	0	5*
	5*	15*	3	13	11*	39
	12	10*	7	8	15	3
	4	3	13	7	13	19*

* Female subjects.

Appendix 4

Original Data Consisting of Trials to Criterion in the Test Problem in Experiment Two

Location of Stimuli During Acquisition	Location of Stimuli During the Test Problem					
	formerly + cue		formerly - cue		no stimuli	
	Normal	Retarded	Normal	Retarded	Normal	Retarded
	4	24	4	6	2*	6*
	14	29	3	11	11	10
	22	23	24	14*	5	10*
	18	30*	8	8*	3*	9*
	25	11*	12	2	20	4
	11	29*	18*	1	24*	29*
	8	1*	18	2	6*	1
	11*	14	4	2	17*	7
	4*	9	10	5	5*	6*
	5	6	4	1	32	3*
	8*	15*	3*	26*	19	13
	17	15*	9*	10*	13	7
	6	4*	28	4*	6*	2*
	9	17*	3	6	1*	3*
	9	3	1	14*	10*	7
	2	14*	6	3*	22	9
	15*	8	1*	4	8*	3
	12*	1	8*	12	7*	24*
	7*	30	4	3*	14*	2*
	6	21	22*	11	13	30
	18*	12	14*	12*	12	7*
	5*	4*	14	9	8*	2
	3	4*	8	7	11	8
	10	8	4	12	1	7*

* Female subjects.

Appendix 5

Original Data for Number of Trials to Acquisition Criterion in Experiment Three

Group Extinguished in Same Room	Group Extinguished in New Room
12*	11*
11*	9*
5*	15*
10*	19*
4*	7*
38*	3*
26*	23*
10*	8*
9	20*
25	7*
9	15
6	21
24	11
11	9
0	4
18	26
42	4
24	21
17	4
9	25

* Female subjects.

Appendix 6

Original Data for Number of Trials to Extinction Criterion in Experiment Three

Group Extinguished in Same Room	Group Extinguished in New Room
13*	10*
22*	16*
48*	38*
24*	15*
37*	7*
90*	9*
17*	9*
17*	21*
65	16*
33	15
16	5
22	21
26	16
25	15
22	6
11	11
56	13
14	6
19	13
16	17

* Female subjects.